Attorney Docket No.: 108-151USAN40

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In Re Continuation Application of:

| | | |
|---|---|---|
| Applicants | : | Constantine J. Tsikos, et al. |
| Application No.: | | 09/990,585 |
| Filing Date | : | November 21, 2001 |

Honorable Commissioner
of Patents and Trademarks
Washington, D.C. 20231

**REQUEST FOR AMENDMENT OF INVENTORSHIP OF UNDER 37 C.F.R. 1.48(b)**

Sir:

Pursuant to the provisions of 37 C.F.R. 1.48(b) the undersigned attorney requests deletion of the following inventors for the present Continuation Application: Michael D. Schnee, Ka Man Au, Allan Wirth, Timothy A. Good, Andrew Jankevics, Sankar Ghosh, Charles A. Naylor, Thomas Amundsen, Robert Blake, William Svedas, Shawn Defoney, Edward Skypala, Russell Joseph Dobbs, George Kolis, Mark S. Schmidt, Jeffery Yorsz, Patrick A. Giordano, Stephen J. Colavito, David W. Wilz, Sr., Barry E. Schwartz, Steve Y. Kim, Dale Fischer, and John Van Tassell.

Upon deletion, the correct list of named inventors will include: Pirooz Vatan, C. Harry Knowles, Xiaoxun Zhu, and Constantine J. Tsikos.

If deemed necessary, the Commissioner is hereby authorized to charge the fee of $130.00, as set forth in §1.17(i), to Deposit Account 16-1340. A copy of this document is included herewith.

Respectfully submitted,

Dated: February 26, 2002

Thomas J. Perkowski, Esq.
Attorney for Applicants
Reg. No. 33,134
Thomas J. Perkowski, Esq., P.C.
Soundview Plaza
1266 East Main Street
Stamford, Connecticut 06902
203-357-1950
http://www.tjpatlaw.com

CERTIFICATE OF EXPRESS MAIL UNDER 37 C.F.R. 1.10

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Nancy Short

Mailer: Nancy Short
Dated: February 26, 2002

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PRELIMINARY AMENDMENT

Sir:

Prior to examination of the above-referenced Patent Application, please amend the same as follows:

AMENDMENT OF THE TITLE TO INVENTION

Please amend the Title To Invention to read as follows:

--PLANAR LASER ILLUMINATION AND IMAGING (PLIIM) BASED CAMERA SYSTEM FOR PRODUCING HIGH-RESOLUTION 3-D IMAGES OF MOVING 3-D OBJECTS--

AMENDMENT OF THE SPECIFICATION:

Please amend the first paragraph of Page 1, entitled "Cross-Reference to Related U.S. Application" as follows:

This is a Continuation of copending Application No. 09/990,585 filed November 21, 2001 which is a Continuation-in-Part of: copending Application Serial No. 09/999,687 [09/---,--- [not yet assigned] ] filed October 31, 2001 [[Attorney Docket 108-146USA000]]; copending Application Serial No. 09/954,477 filed September 17, 2001; copending Application Serial No. 09/883,130 filed June 15, 2001, which is a Continuation-in-Part of Application Serial No. 09/781,665 filed February 12, 2001; copending Application Serial No. 09/780,027 filed February

9, 2001; copending Application Serial No. 09/721,885 filed November 24, 2000; [copending Application Serial No. 09/047, 146 filed March 24, 1998; copending Application Serial No. 09/157,778 filed September 21, 1998; copending Application Serial No. 09/274,265, filed March 22, 1999; International Application Serial No. PCT/US/99/06505 filed March 24, 1999, and published as WIPO WO 99/49411;] Application Serial No. 09/327,756 filed June 7, 1999; and International Application Serial No. PCT/US00/15624 filed June 7, 2000, published as WIPO WO 00/75856 A1; each said application being commonly owned by Assignee, Metrologic Instruments, Inc., of Blackwood, New Jersey, and incorporated herein by reference as if fully set forth herein in its entirety.

AMENDMENT OF THE ABSTRACT:

Please amend the Abstract of the Disclosure to read as follows:

ABSTRACT OF INVENTION

A planar laser illumination and imaging (PLIIM) based camera system for producing high-resolution 3-D images of moving 3-D objects having arbitrary surface geometry. The PLIIM-based camera system comprises a system housing of unitary construction, a LADAR-based object profiling subsystem, a PLIIM-based linear imaging subsystem, and an image processing subsystem disposed therein. The system housing has first, second, third and fourth light transmission apertures linearly aligned with and optically isolated from each other, and the third light transmission aperture is disposed between the first and second light transmission aperture. The LADAR-based object profiling subsystem projects an amplitude modulated (AM) laser beam through the fourth light transmission aperture, and scans the laser beam across an 3-D object surface of arbitrary surface geometry moving past the fourth light transmission aperture. The return AM laser beam is processed in order to measure the surface profile of the moving 3-D object surface and produce a series of linear 3-D surface profile maps thereof. Each linear 3-D surface profile map comprises a set of 3-D coordinates specifying the location of sampled points along the moving 3-D object surface. The PLIIM-based linear imaging subsystem produces a series of linear high-resolution 2-D images of the moving 3-D object surface. Each linear high-resolution 3-D image comprises a set of pixel intensity values, and each pixel intensity value is assigned a set of two-dimensional coordinates specifying the location of the pixel in the linear high-resolution 2-D image. The image processing subsystem automatically processes the linear 3-D surface profile maps and the high-resolution 2-D linear images captured by the subsystems in order to construct high-resolution 3-D images of the 3-D object surface. By virtue of the

present invention, it is now possible to produce high-resolution 3-D images of moving 3-D object surfaces using linear imaging and 3-D profiling techniques.

AMENDMENT OF THE CLAIMS TO INVENTION:

Please cancel Claims 1-669 and add new Claims 670- 675 as follows:

--670. A planar laser illumination and imaging (PLIIM) based camera system for producing high-resolution 3-D images of 3-D object surfaces of arbitrary surface geometry moving relative to said PLIIM based camera system, said PLIIM-based camera system comprising:

a system housing having first, second, third and fourth light transmission apertures linearly aligned with and optically isolated from each other, and said third light transmission aperture being disposed between said first and second light transmission apertures;

an LADAR-based object profiling subsystem, disposed within said system housing, for projecting an amplitude modulated (AM) laser beam through said fourth light transmission aperture, and scanning said laser beam across an 3-D object surface of arbitrary surface geometry moving past said fourth light transmission aperture, so as to measure the surface profile of said moving 3-D object surface and produce a series of linear 3-D surface profile maps thereof as said 3-D object surface moves past said system,

wherein each said linear 3-D surface profile map comprises a set of 3-D coordinates specifying the location of sampled points along said moving 3-D object surface;

a linear imaging subsystem, disposed within said system housing, for producing a series of linear high-resolution 2-D images of said moving 3-D object surface as said 3-D object surface moves past said system,

wherein each said linear high-resolution 3-D image comprises a set of pixel intensity values, and each said pixel intensity value being assigned a set of two-dimensional coordinates specifying the location of the pixel in said linear high-resolution 2-D image, and

wherein said linear imaging subsystem includes

a linear image formation and detection module having image formation optics with a field of view projectable through said third light transmission aperture and onto said 3-D

object surface moving relative to said first, second and third light transmission apertures during object illumination and imaging operations, and

a pair of planar laser illumination arrays (PLIAs) disposed in said system housing, each said planar laser array (PLIA) including a plurality of laser diodes arranged together in a linear manner and said planar laser illumination arrays being arranged in relation to said linear image formation and detection module, and for producing a pair of planar laser illumination beams (PLIBs), and projecting said pair of stationary planar laser illumination beams through said first and second light transmission apertures and oriented such that the plane of said planar laser illumination beams is coplanar with the field of view of said linear image formation and detection module so that the object can be simultaneously illuminated by said planar laser illumination beams and imaged within said field of view of said linear image formation and detection module; and

an image processing computer, for constructing high-resolution 3-D images of said 3-D object surface using said linear 3-D surface profile maps and said high-resolution 2-D linear images of said moving object surface.--

--671. The PLIIM-based camera system of claim 670, wherein said image processing computer is disposed within said system housing.--

--672. The PLIIM-based camera system of claim 670, wherein said image processing computer further comprises:

means for producing a 3-D surface geometry model of said moving 3-D object surface using said linear 3-D surface profile maps;

means for mathematically projecting pixel rays from each pixel in each said captured linear high-resolution 2-D image;

means for computing the x, y, z coordinates associated with the points of intersection between these pixel rays and said 3-D surface geometry model; and

means for generating a linear high-resolution 3-D image of said moving 3-D object surface based on said computed points of intersection,

whereby each pixel in said high-resolution linear 3-D image comprises an intensity value I(x, y, z) and a set of x,y,z coordinate values specifying the location of the sampled point of said moving 3-D object surface.--

--673. The PLIIM-based camera system of claim 672, wherein said image processing computer further comprises means for assembling, in an image buffer, a set of consecutively computed linear high-resolution 3-D images so as to construct an area-type high-resolution 3-D image of said moving 3-D object surface.--

--674. The PLIIM-based camera system of claim 673, wherein said image processing computer further comprises: means for mapping the intensity value I(x', y', z') of each pixel in said computed area-type 3-D image onto the x',y',z' coordinates of points on a uniformly-spaced grid surface positioned along the optical axis of said linear imaging subsystem so as to model a 2-D planar substrate on which graphical forms of intelligence on said 3-D object surface might have been originally rendered; and means, using an intensity weighing function based on the x', y', z' coordinate values of each pixel in said area-type high-resolution 3-D image, for producing an high-resolution area-type 2-D image of said 2-D planar substrate surface bearing said forms of graphical intelligence.--

--675. The PLIIM-based camera system of claim 675, wherein said image processing computer further comprises: an OCR algorithm for performing automated recognition of graphical forms of intelligence that might be possibly contained in said high-resolution area-type 2-D image of said 2-D planar substrate surface so as to recognize said graphical forms of intelligence, and generating symbolic knowledge structures representative thereof.--

--674. The PLIIM-based camera system of claim 670, wherein said linear imaging subsystem comprises a planar laser illumination and imaging (PLIIM) based linear imaging subsystem having a planar laser illumination array for producing a planar laser illumination beam that illuminates said moving 3-D object surface.--

--675. The PLIIM-based camera system of claim 671, wherein said LADAR-based object profiling subsystem produces a pair of AM laser beams, spaced apart at an angular separation, for capturing pairs of linear 3-D surface profile maps which are processed in order to compute the instantaneous velocity of said moving 3-D object surface.--

REQUIREMENT UNDER 37 C.F.R. 1.121

As required under 37 C.F.R. 1.121, a clean version of the first paragraph of Page 1 is as follows:

This is a Continuation of copending Application No. 09/990,585 filed November 21, 2001 which is a Continuation-in-Part of: copending Application Serial No. 09/999,687 filed October 31, 2001; copending Application Serial No. 09/954,477 filed September 17, 2001; copending Application Serial No. 09/883,130 filed June 15, 2001, which is a Continuation-in-Part of Application Serial No. 09/781,665 filed February 12, 2001; copending Application Serial No. 09/780,027 filed February 9, 2001; copending Application Serial No. 09/721,885 filed November 24, 2000; Application Serial No. 09/327,756 filed June 7, 1999; and International Application Serial No. PCT/US00/15624 filed June 7, 2000, published as WIPO WO 00/75856 A1; each said application being commonly owned by Assignee, Metrologic Instruments, Inc., of Blackwood, New Jersey, and incorporated herein by reference as if fully set forth herein in its entirety.

As further required by 37 C.F.R. 1.121, a clean version of the Abstract is set forth as follows:

A planar laser illumination and imaging (PLIIM) based camera system for producing high-resolution 3-D images of moving 3-D objects having arbitrary surface geometry. The PLIIM-based camera system comprises a system housing of unitary construction, a LADAR-based object profiling subsystem, a PLIIM-based linear imaging subsystem, and an image processing subsystem disposed therein. The system housing has first, second, third and fourth light transmission apertures linearly aligned with and optically isolated from each other, and the third light transmission aperture is disposed between the first and second light transmission aperture. The LADAR-based object profiling subsystem projects an amplitude modulated (AM) laser beam through the fourth light transmission aperture, and scans the laser beam across an 3-D object surface of arbitrary surface geometry moving past the fourth light transmission aperture. The return AM laser beam is processed in order to measure the surface profile of the moving 3-D object surface and produce a series of linear 3-D surface profile maps thereof. Each linear 3-D surface profile map comprises a set of 3-D coordinates specifying the location of sampled points along the moving 3-D object surface. The PLIIM-based linear imaging subsystem produces a series of linear high-resolution 2-D images of the moving 3-D object surface. Each linear high-resolution 3-D image comprises a set of pixel intensity values, and each pixel intensity value is assigned a set of two-dimensional coordinates specifying the location of the pixel in the linear high-resolution 2-D image. The image processing subsystem automatically processes the linear 3-D surface profile maps and the high-resolution 2-D linear images captured by the subsystems in order to construct high-resolution 3-D images of the 3-D object surface. By virtue of the present invention, it is now possible to produce high-resolution 3-D images of moving 3-D object surfaces using linear imaging and 3-D profiling techniques.

Also required under 37 C.F.R. 1.121, a clean set of the amended Claims is provided herebelow:

670. A planar laser illumination and imaging (PLIIM) based camera system for producing high-resolution 3-D images of 3-D object surfaces of arbitrary surface geometry moving relative to said PLIIM based camera system, said PLIIM-based camera system comprising:

a system housing having first, second, third and fourth light transmission apertures linearly aligned with and optically isolated from each other, and said third light transmission aperture being disposed between said first and second light transmission apertures;

an LADAR-based object profiling subsystem, disposed within said system housing, for projecting an amplitude modulated (AM) laser beam through said fourth light transmission aperture, and scanning said laser beam across an 3-D object surface of arbitrary surface geometry moving past said fourth light transmission aperture, so as to measure the surface profile of said moving 3-D object surface and produce a series of linear 3-D surface profile maps thereof as said 3-D object surface moves past said system,

wherein each said linear 3-D surface profile map comprises a set of 3-D coordinates specifying the location of sampled points along said moving 3-D object surface;

a linear imaging subsystem, disposed within said system housing, for producing a series of linear high-resolution 2-D images of said moving 3-D object surface as said 3-D object surface moves past said system,

wherein each said linear high-resolution 3-D image comprises a set of pixel intensity values, and each said pixel intensity value being assigned a set of two-dimensional coordinates specifying the location of the pixel in said linear high-resolution 2-D image, and

wherein said linear imaging subsystem includes

a linear image formation and detection module having image formation optics with a field of view projectable through said third light transmission aperture and onto said 3-D object surface moving relative to said first, second and third light transmission apertures during object illumination and imaging operations, and

a pair of planar laser illumination arrays (PLIAs) disposed in said system housing, each said planar laser array (PLIA) including a plurality of laser diodes arranged together in a linear manner and said planar laser illumination arrays being arranged in relation to said linear

image formation and detection module, and for producing a pair of planar laser illumination beams (PLIBs), and projecting said pair of stationary planar laser illumination beams through said first and second light transmission apertures and oriented such that the plane of said planar laser illumination beams is coplanar with the field of view of said linear image formation and detection module so that the object can be simultaneously illuminated by said planar laser illumination beams and imaged within said field of view of said linear image formation and detection module; and

an image processing computer, for constructing high-resolution 3-D images of said 3-D object surface using said linear 3-D surface profile maps and said high-resolution 2-D linear images of said moving object surface.

671. The PLIIM-based camera system of claim 670, wherein said image processing computer is disposed within said system housing.

672. The PLIIM-based camera system of claim 670, wherein said image processing computer further comprises:

means for producing a 3-D surface geometry model of said moving 3-D object surface using said linear 3-D surface profile maps;

means for mathematically projecting pixel rays from each pixel in each said captured linear high-resolution 2-D image;

means for computing the x, y, z coordinates associated with the points of intersection between these pixel rays and said 3-D surface geometry model; and

means for generating a linear high-resolution 3-D image of said moving 3-D object surface based on said computed points of intersection,

whereby each pixel in said high-resolution linear 3-D image comprises an intensity value I(x, y, z) and a set of x,y,z coordinate values specifying the location of the sampled point of said moving 3-D object surface.

673. The PLIIM-based camera system of claim 672, wherein said image processing computer further comprises means for assembling, in an image buffer, a set of consecutively computed

linear high-resolution 3-D images so as to construct an area-type high-resolution 3-D image of said moving 3-D object surface.

674. The PLIIM-based camera system of claim 673, wherein said image processing computer further comprises: means for mapping the intensity value I(x', y', z') of each pixel in said computed area-type 3-D image onto the x',y',z' coordinates of points on a uniformly-spaced grid surface positioned along the optical axis of said linear imaging subsystem so as to model a 2-D planar substrate on which graphical forms of intelligence on said 3-D object surface might have been originally rendered; and means, using an intensity weighing function based on the x', y', z' coordinate values of each pixel in said area-type high-resolution 3-D image, for producing an high-resolution area-type 2-D image of said 2-D planar substrate surface bearing said forms of graphical intelligence.

675. The PLIIM-based camera system of claim 675, wherein said image processing computer further comprises: an OCR algorithm for performing automated recognition of graphical forms of intelligence that might be possibly contained in said high-resolution area-type 2-D image of said 2-D planar substrate surface so as to recognize said graphical forms of intelligence, and generating symbolic knowledge structures representative thereof.

674. The PLIIM-based camera system of claim 670, wherein said linear imaging subsystem comprises a planar laser illumination and imaging (PLIIM) based linear imaging subsystem having a planar laser illumination array for producing a planar laser illumination beam that illuminates said moving 3-D object surface.

675. The PLIIM-based camera system of claim 671, wherein said LADAR-based object profiling subsystem produces a pair of AM laser beams, spaced apart at an angular separation, for capturing pairs of linear 3-D surface profile maps which are processed in order to compute the instantaneous velocity of said moving 3-D object surface.

REMARKS

The Commissioner is authorized to charge any fee deficiencies to Deposit Account No. 16-1340. A duplicate of this document is enclosed herewith.

Respectfully submitted,

Dated: February 26, 2002

Thomas J Perkowski, Esq.
Attorney for Applicants
Reg. No. 34,134
Thomas J. Perkowski, Esq., P.C.
Soundview Plaza
1266 East Main Street
Stamford, Connecticut 06902
203-357-1950
http://www.tjpatlaw.com

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Mailer: Nancy Short
Dated: February 26, 2002